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Management of ASW Systems: A Look at Rotary Wing ASW

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ASW is not a static problem and the U.S. Navy must continue to improve its capabilities. This paper, the original version of which was prepared by a student at the Naval War College as a requirement of the course, argues that we cannot afford to ignore the continued effectiveness of the helicopter as the heart of an efficient ASW system.

MANAGEMENT OF ASW SYSTEMS:

A LOOK AT ROTARY WING ASW

by

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With Defense Department resources becoming increasingly scarce, congressional scrutiny becoming even more intense, and the public becoming increasingly apathetic about defense, military decisionmakers must devote careful attention to ensuring that our combat capability is optimized for each defense dollar invested. This study looks at one portion of the triple threat environment of today's aircraft carrier and its integrated air wing, the subsurface threat to our surface Navy especially within the naval strike force outer zone area, i.e., 90 nautical miles.

The Secretary of Defense, Harold Brown, has stated that "The U.S. is a maritime nation. Much more than the Soviet Union, we depend on access to major air and sea lanes not only to acquire critical raw materials and engage in other peaceful pursuits, but also to protect our vital interests, forces, and allies overseas in wartime."[1] He further states (in his FY-79 Annual Report) that

> . . . one of the main functions of the U.S. Navy is to protect our merchant shipping from attack. In order to do so, we must concentrate resources on anti-submarine warfare (ASW) and seaborne anti-air warfare (AAW) rather than on a major anti-shipping capability designed to interdict sea lanes that the Soviets would not use in wartime.[2]

Using these statements as a portion of the DOD's approach to achieving its objective of deterrence, Admiral Holloway, in his FY-79 CNO Report, said:

> The Soviets have the largest submarine force in the world and continue to improve its capabilities. Since the 1960s, *submarines armed with torpedoes and cruise missiles have presented the most severe threat to all naval surface*

> *forces* (writer's emphasis) and, with the other Soviet attack submarines, could present an extremely serious threat to western SLOCs in a protracted conflict.[3]

Because many other documents, studies, and news media articles[4] are replete with such pessimistic assessments of the Soviet Navy's threat, it is sufficient to state that the trends indicate that the Soviet Navy is emerging toward achievement of a worldwide mission of sea control and power projection. The subsurface threat becomes increasingly apparent when one is reminded that each Soviet cruise missile submarine carries from two to six times as many torpedoes as missiles. If these missile and torpedo submarines were employed not only against our naval forces, but also against our merchant shipping and replenishment forces, the results could be devastating. Therefore, the Soviet's and other potential adversary's submarine forces are a genuine threat to today's Navy, and the trends indicate that the Soviet Navy's capability is apt to continue to increase as its equipment becomes more and more sophisticated.

In view of this Soviet trend toward quantitative increases and qualitative improvements in their submarine force, antisubmarine warfare is and must remain among the very highest priorities for the United States. In order to enable the U.S. Navy to achieve not only parity with this threat, but to ensure deterrence through continued U.S. superiority in ASW, the U.S. Navy must continue to improve its ASW capability. But ASW systems must compete with many equally important defense programs for the limited funds needed to ensure this superiority. In addition to competing with other DOD programs, each ASW project must compete for adequate funding among other equally attractive ASW programs. So, how should a decisionmaker decide where to invest his ASW funds? Certain economic concepts of the business firm are applicable to such force planning decisions.

Complementarity of ASW Forces. Because the aim of the U.S. Navy's ASW forces is to deny the enemy the effective use of his submarines, how is this goal most effectively and efficiently achieved? Admiral Holloway states that

> the art of naval warfare is to employ surface, submarine and air forces in such a manner as to exploit the strengths and minimize the weaknesses of each. This objective has led to the integrated operation of surface, submarine, and air forces operating together in mutual support with the common objective of gaining advantage over the enemy by enhancement of offensive capabilities and decreasing individual vulnerabilities.[5]

The achievement of this maximum effort is possible only through the application of the economic concept of complementarity. While no one will deny that aircraft, ships and submarines are all "effective" ASW systems, the proper integration of each of these oftentimes dissimilar systems will result in the attainment of maximum ASW capability: together they produce an integrated ASW capability greater than the sum of the individual ASW systems.

Allocating ASW Funds. Our Navy decisionmakers' tasks could be reduced significantly if each of the various ASW systems were substitutes for one another. If a linear relationship could be derived for ASW ships, aircraft and submarines, the weapon system that operates in the same medium as the threat (water) would have a distinct advantage over the others, i.e., the most effective. But the variables of resource allocation and cost have a dynamic effect on every DOD decision. The procurement and the operation of more

ASW SSN submarines is one alternative in gaining maximum ASW effectiveness, but cost and reaction time become limiting factors. The new 688-class SSN submarines significantly contribute to our qualitative ASW advantage but their cost prohibits mass production. It would be ideal if one could use quantitative linear programming to compare the cost and effectiveness of all ASW systems. Using that economic tool, the decisionmaker could then procure and operate the most cost-effective weapon system. In theory that may be possible but the results would be meaningless. It must be reemphasized that all of the U.S. Navy's ASW systems are complementary, not substitutes for each other. In different environments, against a variety of threats and when countermeasures are introduced, each ASW system has unique assets and liabilities.

As no direct linear relationship exists between complementary ASW weapon systems, how does a Navy or DOD decisionmaker allocate his continually scarce resources (dollars) among several alternative ASW programs? Funds cannot be allocated to the ASW platform based upon the persuasive ability of program advocates (salesmanship) or the "union's" (air, surface, submarine) lobbying effort. Resource allocation should be selected upon potential combat effectiveness and uncertainty/risk. This is an enviable goal, but how is it achieved? The economic principle of marginalism is but one proven tool that may be employed to assist the decisionmaker in allocating funds.

Air ASW Marginal Analysis. Initially, a problem exists in quantifying the current Measure-Of-Effectiveness (MOE) for the existing VP, VS, HS, and HSL weapon systems, as well as predicting the MOE of future systems (e.g., P-3C Update III, LAMPS MK-III, etc.). This determination of MOE for existing systems is especially challenging when one considers the differences in total capability of each weapon system. But it should be possible to correlate the relative size of the areas of uncertainty for each aircraft with the time required to execute a successful attack on the target submarine. The Navy's old FIXWEX (Fixed Wing ASW Evaluation Exercise) exercises and the present AIREM (Air Readiness/Effectiveness Measurement Program) exercises are programs used to assess air ASW weapon system effectiveness. It is apparent that the requirement exists for the Navy to measure the effectiveness of current systems both when employed independently and in a coordinated manner. Once a level of effectiveness is determined for each system, marginal analysis can be used to compare the cost of new equipment with the proportional increase in ASW combat effectiveness. Ideally, each expenditure for new ASW equipment/systems will produce an improvement in the combined ASW effectiveness of the U.S. Navy, remembering that each ASW system complements the others.

Helicopter Antisubmarine Warfare: Its Past. Helicopter ASW has been a proven system for many years with the tethered, variable-depth sonar as its primary sensor. The SH-34/SH-3 helicopters and the S-2 airplanes were an effective team in hunter-killer task groups of the 1950s and 1960s. As the CVS carriers met their demise, CVA attack carriers were converted into the multimission CVs of today. The sophisticated S-3A "Viking" has replaced the S-2G *Tracker*, the SH-2D/F LAMPS MK-I is in the fleet, and the SH-3 *Sea King* has undergone a significant number of modifications to meet changing challenges. The mission of today's SH-3H *Sea King* is to provide local ASW protection for the carrier, i.e., search, localization, classification and attack of submarines out to and including the second convergence zone (encompasses the naval strike force outer zone area).

The SH-3H retains its secondary utility missions that are similar to other Navy helicopters: SAR (search and rescue), medical evacuation, logistics support, mail delivery, etc.

The SH-3As of the early 1960s were configured with AQS-10 dipping sonar as their sole acoustic sensor. The SH-3D models of the late sixties increased the helicopter's endurance to 5½ hours and added the improved AQS-13A sonar. Later models of the SH-3D and the SH-3Hs of the 1970s received the latest AQS-13B sonar and the AQS-81 MAD (magnetic anomoly detection) equipment. In order to enable the SH-3s to employ sonobuoy acoustic information, the SH-3A/D/Hs of the mid-1970s sported a variety of data link systems. ALR-54 ESM (electronic surveillance measures) and LN-66 radar systems were also installed on the original SH-3Hs that were used during the interim sea control ship trials aboard U.S.S. *Guam* (LPH-9) in 1972.[6] Dipping sonar has remained the primary acoustic sensor for all models of the SH-3 for over 18 years.

During the mid-1970s an effort was made to quantify the value of the SH-3s aboard the CV to determine if the SH-3 mission could be adequately accomplished by other ASW assets—the SH-2F LAMPS MK-I helicopter, VP, or surface combatants. This reevaluation of HS effectiveness was prompted in part by fleet introduction of the new S-3A, which complicated the critical deck loading of all CVs. CVA skippers were also accustomed to having the embarked helicopters perform the missions of combat SAR, plane guard, mail/cargo delivery, etc. ASW was perceived by many to be the responsibility of the surface ships in company with the CV. But, as "War-At-Sea" exercises dramatically demonstrated after the end of the Vietnam conflict, CVs were especially vulnerable without an effective local air ASW system. These exercises and the CNO-directed reevaluation of HS effectiveness reemphasized the value of the SH-3's ASW systems; they could consistently detect and destroy submarines within the missile-firing radius surrounding the carriers. The failure of other air ASW units to detect these exercise submarines (simulating *Foxtrot, Echo II, Charlie* and *Victor* Soviet submarines) serve as a grim reminder that sonobuoys alone will not suffice. Covert ASW operations were also in vogue at that time and HS squadrons recorded an impressive number of confirmed detections in the high noise environment of the carrier task group. In locations with high ambient noise (e.g., the Mediterranean) and high reverberation shallow water conditions (e.g., amphibious landings), the SH-3's dipping sonar proved its effectiveness. Acoustic sonar detections confirmed by MAD led to a high rate of success for the SH-3s. When the SH-3s were fitted with the MK-46 hover-launch torpedo capability in the mid-1970s the helicopter fire control solution was simplified, bringing the HS successful attack score to an impressive level. The SH-3's previous performance has been qualitatively recorded (e.g., cruise reports), but supporting quantitative data is unfortunately of minimal value owing to the lack of standardized methodology/analysis.

HS Today. With this level of performance, why did the CNO direct a restructure of HS squadrons in March 1977? "Fiscal constraints" were cited as the reason for reducing the HS squadron UE (unit equipage) from 8 to 6 helicopters commencing in FY-78. If the SH-3 weapon system was so effective, why the reduction in forces? Why is there no follow-on airframe programmed to replace the aging SH-3 helicopter? Why was the HSX program terminated? Why is the HS squadron so casually dismissed from all discussions of the development of new aircraft carrier/VSTOL employment? Systems analysis and other economic concepts seem not to have been sufficiently or properly used in substantiating the effectiveness of the present HS weapon system. Systems analysis should not be used to support the program advocate's parochialism, but quantitative economic concepts and comparisons should be used to support the expenditure of funds on future HS concepts. As with all weapon systems, there is some risk in advertising the present effectiveness of the SH-3. If present effectiveness is determined to be low, program opponents will be able to state that the system is not worth the cost. If present effectiveness is determined to be high, these same opponents can criticize improvement programs as not being necessary.

Today, one of the most formidable problems for the CV is the missile-firing SSGN that is usually undetected by other than HS units until it is within missile-firing range. When the CV's inner zone is threatened by an SSGN, its only option is to try to outrun the submarine, its missiles, and its torpedoes. Passive VP, VS, hull-mounted SQS-26 surface ships, and even TASS/TACTASS ships are ineffective in such high noise conditions but the SH-3's active sonar and prompt attack capability are most effective in keeping a threatening submarine submerged, thereby preventing the submarine from obtaining a refined fire-control solution. Submarine skippers have been quoted as saying that the ASW system most difficult to break contact with is the sonar-equipped SH-3, even with the submarine employing countermeasures. These capabilities have been subjectively voiced for several years but each "opinion" has failed to curtail cutbacks in HS forces. One reason for these continual budget reductions has been the highlighting of known system deficiencies, while failing to recognize the weapon system's proven performance. Astute salesmanship by fellow ASW communities has been highly successful in obtaining the necessary funds for their systems. But salesmanship will not suffice; quantitative plus qualitative analysis should be used in making these decisions. Again, proven performance reduces uncertainty and must be used in making a rational decision when allocating resources.

The most restrictive liability for the SH-3 has been its inability to navigate accurately and reliably. This is of paramount importance in coordinated ASW prosecutions. The recently completed OPEVAL (Operational Evaluation) on the SH-3H ASN-123 Tactical Navigation (TACNAV) system quantitatively proved that this handicap has been overcome at minimal cost.[7] The HS aircrew now has a real-time display of the tactical situation, thereby facilitating the tactical decisionmaking process. As a result of this OPEVAL, all future SH-3Hs will be outfitted with the ASN-123 TACNAV. Another restriction on the effectiveness of the SH-3H has been the relatively small area of uncertainty that the helicopter could search. Even with MCJR (multichannel jezebel relay) or AKT-22 data link, the SH-3s have been limited because they must remain in line-of-sight with the CV for sonobuoy acoustic data link. Another limitation has been the time needed to convert an initial "trigger" contact from another ASW unit into a successful attack. The AQS-13E/Sonar Data Computer (SDC) has just recently completed TECHEVAL (Technical Evaluation) and has shown that this on-board acoustic processor can overcome these limitations. This capability to process its own sonobuoys is now being demonstrated during the OPEVAL aboard a LANTFLT ship. Working in conjunction with the S-3A, the VS/HS test team will operationally quantify the SH-3H's ASW capability of protecting the CV task group. Benefits should include a reduction in the response time from the initial detection to target kill, which is crucial in the event that an attack on the CV is imminent. With both TACNAV and the SDC, the SH-3H will be able to localize submarines more quickly and within a much larger area of uncertainty. The SH-3H's navigation and acoustic/nonacoustic detection capability with TACNAV and SDC is a significant hedge against data link interruption or RF jamming on the sonobuoy VHF frequencies.

Rotary Wing Aircraft of the 1990s. The Navy's current inventory includes 256 H-3 and 95 SH-2 LAMPS MK-I ASW helicopters. The Navy recently informed the Senate Armed Services Committee that it could restructure the SH-60B LAMPS MK-III program to save $401.2 million, thereby preventing the total cancellation of the $3.9 billion program.[8] The Navy expects to continue with 12 CVs in commission into the 1990s with dozens of new DD-963 ASW destroyers and FFG-7 ASW frigates entering the fleet. A careful analysis of the Soviet submarine threat and the proper allocation of funds among competing ASW systems demands that the Navy's decisionmakers use the most cost-effective alternative in satisfying the ASW Mission Element Need Statements (MENS) and the fleet's operational requirements.

Applicable economic decision tools should be employed to determine optimal ASW decisions in the future, with particular emphasis on reducing uncertainty. Because rotary wing technology has improved consistently over the past 30 years, the helicopter is the one ASW platform known to be able to be integrated with other ASW systems for optimum total ASW effectiveness. Proven aircraft performance should be included in any analysis to determine whether and when future VSTOL aircraft will be substitutes for current helicopters. In both the immediate and far future, rotary wing ASW will continue to complement other ASW systems. Economic efficiency and maximum ASW combat effectiveness will concomitantly be achieved by the Navy when these complementary ASW systems are operated in a coordinated mode.

The Navy is investing a record amount of funds on such ASW systems as the P-3C Update III's new IBM digital acoustic processor called "Proteus," LAMPS MK-III, improvements on the S-3A, new surface ASW combatants, SOSUS improvements and towed hydrophone arrays.[9] Each of these programs is vitally important to prevent stagnation in our ASW posture. Vice Admiral Waller warns that " . . . our problem will never be totally solved. ASW forces can never expect to gain the upper hand completely."[10] The Navy must continue the effort to ensure ASW superiority, but this should not be done at the expense of sacrificing current effectiveness, nor cause us to take unnecessary risks. The continual budget constraints applied to the HS community are sacrificing current combat effectiveness (e.g., UE reduction from 8 to 6). These budget reductions in both HS R&D and operating funds are providing additional funds for competing ASW programs, but may lead us into a trap. That crevasse is the predominant reliance on deployable, expendable acoustic detection systems (sonobuoys) that may make existing and even future passive acoustic systems such as "Proteus" obsolete within a decade. Active ASW systems should not be sacrificed to gain improved passive capabilities, especially when deception and countermeasures oftentimes render passive systems ineffective. The same can be said about the Navy's overwhelming reliance on future VSTOL technological achievements. Let us not sacrifice currently proven effective ASW systems and aircraft in our search for "something more."

The SH-60B LAMPS MK-III is a modern rotary wing weapon system capable of ASW, ASST (Antiship Surveillance and Targeting) and utility missions. The SH-60B's ASW and ASST systems are "state of the art." A low risk and low cost modification of the planned SH-60B sensor suite could retain the invaluable tethered, variable-depth active/passive sonar for acoustic prosecution of threat submarines in the high noise inner zone that surrounds the CV. This is especially attractive from a cost-effectiveness viewpoint as new sonobuoys (DICASS, ERAPS, etc.) are very expensive, expendible sensors; they cannot be retrieved or the hydrophones raised as can a helicopter's sonar transducer, and each has unique acoustic capabilities in different acoustic environments (deep, shallow, high noise, etc.). If procurement funds are not sufficient to permit a modification of the current SH-60B ASW/ASST suite, the proven effective and reliable TACNAV and SDC systems could be installed in the SH-60B airframe thereby retaining the sonobuoy processing and downlink command function for the new command activated buoys. Tests are underway at the Naval Air Development Center to evaluate the improved AQS-18 tethered sonar that began as a U.S. Navy project (AQS-13D) and was later purchased by the Federal Republic of Germany. This improved version of the basic AQS-13 style sonar includes 1,500 feet of cable vice 450 feet, an improved passive detection capability, and other improvements to increase its effectiveness in both shallow and deep water. It has also been specifically designed to counter the Soviet's quiet diesel submarine threat. Because of weight/space restrictions in the SH-60B, it is anticipated that a portion of the MK-III avionics suite will have to be removed in order to incorporate the sonar system. The fact remains that whatever the avionics suite is for the HS variant of the SH-60B, a common aircraft for both HS and HSL squadrons will greatly reduce logistics support, reduce life cycle costs, and enable the Navy to reap the benefits of the contractor's learning curve, i.e., lower unit cost. It is possible that the LAMPS MK-III is the perfect choice to fill the CV's ASW requirements of the 1990s as the aging SH-3s are retired. Congressional scrutiny of the MK-III program can be expected to be even more intense, so the lower unit cost should be attractive to those decisionmakers.

The U.S. Navy will probably always have some sort of SAR/logistics rotary wing aircraft aboard its CVs until the last CV (small, medium, or large) is decommissioned. VSTOL "A" will not be a substitute for the plane guard/utility helicopter. A new utility helicopter could be procured to replace the SH-3. This option, however, would severely reduce the CV's combat capabilities at a time when the Soviet submarine threat continues to grow. Every aircraft in the CV's air wing must contribute to the CV's mission—not merely passive, defensive protection, but the ability to wage a successful, offensive war at sea. The S-3A cannot be retrieved from its outer zone missions if the CV is to survive in the face of the Soviet missile threat (surface tattletales with missile-firing SSGNs). An ASW and ASST capable rotary wing aircraft is required for the CV of the future. The sensor suite is available, and the aircraft is undergoing final development—the SH-60B with the improved AQS-18 tethered sonar.

Spinoffs. Lessons learned from our allies (U.K., Federal Republic of Germany, Canada, etc.) as well as from the Soviet's continued emphasis on tethered sonar-equipped helicopters (Hormone "A" and "B" aboard *Kiev*) give additional credibility to the above recommendation. An additional benefit of incorporating a new helicopter with VDS (variable depth sonar) into the CV air wing of the 1990s is the capability to disperse these valuable air assets to other air-capable ships. With its autonomous capabilities, it could be tactically embarked aboard dozens of service force and amphibious ships, as well as aboard surface combatants that will have open decks. Assets from HS squadrons could also be embarked in MSC (Military Sealift Command) ships for harbor sanitization and convoy protection during nonmobilization contingencies or war. (The "ARAPAHO" project proposed deploying Reserve HS detachments aboard MSC and merchant containerized ships.) With its integral tactical navigation system, tethered active/passive sonar, sonobuoy processing capability, MAD, radar, ESM, and the improved MK-46 Neartip air/hover launched torpedo, the HS helicopter could easily satisfy a large variety of ASW/ASST missions. Dispersal of these HS helicopters may be one method by which the Navy can attempt to meet the challenges presented by the NATO resupply mission. There is no need for the Navy to wait for a technological breakthrough in VSTOL R&D. Almost all of the primary and collateral tasks envisioned for the VSTOL Type A can be accomplished with a rotary wing aircraft with much less risk, uncertainty and cost. Aircraft speed, of course, will probably always be a limiting factor for rotary wing aircraft. The route leading to VSTOL Types "A" and "B" has been chosen by the Navy, but let us not forget that other systems are complementary, especially the rotary wing helicopter.

Summary. In view of the increasing Soviet submarine threat, severe budget constraints, and inflation, innovative ideas are required to enable our Navy to meet the challenges of the future. Lest we become overly optimistic or dangerously complacent, the Navy's decisionmakers must assess the ASW capabilities of our present systems objectively, and then make some very astute, difficult decisions. Renewed emphasis should be placed on the complementary nature of all of our current ASW systems. Increased coordination, C^3, and genuine dialogue between participants will necessarily lead to an increase in overall combat effectiveness. Decisions on R&D expenditures must be seasoned by threat and technological predictions along with an accurate assessment of the risk required. Procurement and full-scale development decisions for future ASW systems must be based on the results of realistic operational testing. Adversaries of the U.S. Navy possess a very potent submarine capability and the challenge must be met with more than "Yankee Ingenuity." That "something more" is dedication to endeavors that minimize risk while delivering the most operationally effective and operationally suitable weapon systems to the fleet. Helicopters and VDS are proven systems that, when mated together, give the Navy an effective ASW system that will help us meet the challenges of the 21st century.

BIOGRAPHIC SUMMARY

Lieutenant Commander Arends was commissioned in 1968 after graduating from St. Mary's College, Minnesota. Prior to entering the present class of the Naval War College he served as Helicopter ASW (HS) Operational Test Director in VX-1 at NAS Patuxent River. He has published articles in *Naval Aviation News* and *Campus* and was the author of the OPTEVFOR Tactics Guide for the new TACNAV-equipped SH-3H helicopter.

NOTES

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